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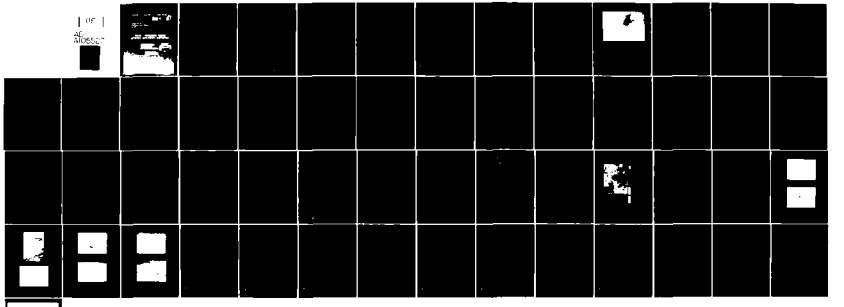

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Approved for release; distribution unlimited.

Leonard M. Krazinski

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

SUBJECT: Gudaitis Lake Dam (MO 30702); Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Gudaitis Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

5 JAN 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

5 JAN 1981
Date

GUDAITIS LAKE DAM

Washington County, Missouri

Missouri Inventory No. 30702

Phase I Inspection Report

National Dam Safety Program

Prepared by

Woodward-Clyde Consultants

Chicago, Illinois

Under Direction of

St Louis District, Corps of Engineers

for

Governor of Missouri

November 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is not to provide a complete evaluation of the safety of the structure nor to provide a guarantee on its future integrity. Rather the purpose of the program is to identify potentially hazardous conditions to the extent they can be identified by a visual examination. The assessment of the general condition of the dam is based upon available data (if any) and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies. In view of the limited nature of the Phase I studies no assurance can be given that all deficiencies have been identified.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with any data which may be available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action removes the normal load on the structure, as well as the reservoir head along with seepage pressures, and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, so that corrective action can be taken. Likewise continued care and maintenance are necessary to minimize the possibility of development of unsafe conditions.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Gudaitis Lake Dam
State Located	Missouri
County Located	Washington
Stream	Unnamed Tributary of Clear Creek
Date of Inspection	18 July 1980

Gudaitis Lake Dam, Missouri Inventory No. 30702, was inspected by Richard Berggreen (engineering geologist), Leonard Krazynski (geotechnical engineer), John Seymour (geotechnical engineer), and Sean Tseng (hydrologist). The dam is an earth dam constructed for recreational purposes.

The dam inspection was made following the guidelines presented in the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines represent a consensus of the engineering profession. These guidelines are intended to provide for an expeditious identification of those dams which may pose hazards to human life or property, based on available data and a visual inspection. In view of the limited scope of the study, no assurance can be given that all deficiencies have been identified.

The St Louis District, Corps of Engineers (SLD) has classified this dam as having a high hazard potential. The hazard zone length estimated by the SLD extends approximately two miles downstream of the dam. Within this zone are at least three occupied homes, other buildings and an electric transmission line. The narrow downstream valley and the closeness and apparent elevation of the occupied dwellings near the stream elevation, indicate 100 percent of the Probable Maximum Flood (PMF) should be used as the design flood. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Gudaitis Lake Dam is in the small size classification based on its maximum height of 25 ft and on its reservoir storage volume of about 180 ac-ft. The small dam classification includes dams between 25 and 40 ft in height or having storage capacities between 50 and 1000 ac-ft.

Our inspection and evaluation indicate the dam is in fair condition. This evaluation is primarily based on hydrologic analyses that indicate that a flood greater than 12 percent of the PMF will effectively overtop the dam. The dam will also be effectively overtopped by the one percent probability-of-occurrence (100 year) flood event. A 40 ft wide zone of slow seepage was noted at the toe of the dam, but the seepage water was not transporting any soil particles at the time of our inspection. The downstream face of the dam is heavily vegetated with relatively young trees up to 12 in. in diameter. This vegetation obscurred portions of the dam from inspection.

The spillway discharge channel is narrow and shallow and is bordered by many large trees. Deep gulley erosion is occurring where this channel traverses steeper slopes. Flood flows in this channel could cause overtopping of the channel and erosion of the channel walls, resulting in possible erosion at the toe of the dam.

Based on our evaluation of the information obtained from the visual inspection and other available information, the following specific recommendations are made for Gudaitis Lake Dam:

1. Preparation of a more detailed hydrologic analysis and a design of a spillway and downstream channel capable of passing 100 percent of the PMF. This design should include an appropriate erosion control system in the spillway and downstream discharge channel.

2. Removal of large trees and other detrimental vegetation from the vicinity of spillway discharge channel banks and downstream dam face. Removal of large trees should be done under the guidance of an engineer experienced in the design and construction of earth dams. Indiscriminate cleaning of trees could jeopardize the safety of the dam.

3. Investigation of the feasibility of a warning system to alert downstream residents should potentially hazardous conditions develop during periods of heavy precipitation.

4. Preparation of static and seismic stability analyses and a seepage analysis for the existing structure to meet the "Recommended Guidelines for Safety Inspections of Dams".

It is also recommended that an inspection and maintenance program be initiated for this facility. This program should include but not be limited to the following:

1. Checking for evidence of slope instability such as slumps on the dam face or settling of the dam crest;

2. Checking the amount and turbidity of seepage;

3. Maintaining the spillway discharge channel and dam slopes free of potential obstructions such as trees and bushes.

These recommendations should be under the guidance of an engineer experienced in the design, construction and maintenance of earth dams.

It is recommended the owner take action without undue delay to avoid deterioration of the facility.

WOODWARD-CLYDE CONSULTANTS

Richard G. Berggreen
Registered Geologist

Leonard M. Krazynski, P.E.
Vice President

OVERVIEW

GUDAITIS LAKE DAM

MISSOURI INVENTORY NUMBER 30702

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GUDAITIS LAKE DAM - MISSOURI INVENTORY NO. 30702
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GUDAITIS LAKE DAM, MISSOURI INVENTORY NO. 30702

SECTION 1
PROJECT INFORMATION

1.1 General

a. **Authority.** The National Dam Inspection Act, Public Law 92-367, provides for a national inventory and inspection of dams throughout the United States. Pursuant to the above, an inspection was conducted of the Gudaitis Lake Dam, Missouri Inventory Number 30702.

b. **Purpose of investigation.** "The primary purpose of the Phase I investigation program is to identify expeditiously those dams which may pose hazards to human life or property... The Phase I investigation will develop an assessment of the general condition with respect to safety of the project based upon available data and a visual inspection, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted" (Chapter 3, "Recommended Guidelines for Safety Inspection of Dams").

c. **Evaluation criteria.** The criteria used to evaluate the dam were established in the "Recommended Guidelines for Safety Inspection of Dams", Engineering Regulation No. 1110-2-106 and Engineering Circular No. 1110-2-188, "Engineering and Design National Program for Inspection of Non-Federal Dams", prepared by the Office of Chief of Engineers, Department of the Army, and "Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams," prepared by the St Louis District, Corps of Engineers (SLD). These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. **Description of dam and appurtenances.** Gudaitis Lake Dam is an earth dam impounding a lake used for recreational purposes. The dam crest varies in elevation from 1107.8 to 1109.9 ft and is grass covered. The spillway is at the right (southeast) abutment and is cut into the natural hillside. It is grass-lined with a gravel lining down its center. The spillway discharge channel joins the drainage channel of the wet-weather creek about 175 ft downstream from the dam. There are no control structures for regulating spillway flows.

b. **Location.** The dam is located on an unnamed tributary of Clear Creek, approximately 2.5 miles northwest of the town of Belgrade in Washington County, Missouri, Section 26, T36N, R1E. It is located on the USGS Palmer 7.5 minute quadrangle map (Fig 1).

c. **Size classification.** The dam is classified as small due to its 25 ft height and 180 ac-ft storage capacity. The small size classification is based on a 25 to 40 ft height or 50 to 1000 ac-ft storage volume.

d. **Hazard classification.** The St Louis District, Corps of Engineers (SLD), has classified this dam as having a high hazard potential; we concur with this classification. The SLD estimated damage zone length extends approximately two miles downstream. Located in this zone are at least three occupied structures, several barns and an electric utility transmission line (Photos 1 and 4).

e. **Ownership.** The dam is reportedly owned by Mr John Gudaitis. Correspondence is to be directed to Mr Gudaitis at 5902 Stately Ave, St Louis, Missouri 62123.

f. **Purpose of dam.** The reservoir created by the dam is used for recreational purposes.

g. **Design and construction history.** No design or construction reports were found for Gudaitis Lake Dam. All design and construction information has been obtained from interviews with Mr Gudaitis.

Mr Gudaitis built the dam in 1968. It was constructed by first excavating the residual soil to shallow bedrock, then using borrow from the reservoir area (mostly the northern slope) to construct the dam. The soil is primarily a stoney residual clay (CL-CH) and was pushed by a bulldozer (Caterpiller D-4) or trucked to the site and dumped. The fill was compacted by dump truck traffic and by driving the bulldozer across the fill. No low level outlets or drains were installed.

According to Mr Gudaitis, the upstream slope was constructed at about 3(H) to 1(V) and the downstream slope was constructed at about 2(H) to 1(V). Gravel and logs were placed on the upstream face for wave erosion protection.

The spillway was constructed on in situ gravelly residual clay soil on the southern valley slope by bulldozer excavation. It is about one bulldozer blade wide and has a 2 to 3 ft high sidewall, on the north side, composed of the excavated and mounded material (Photos 2 and 3).

A small pond was constructed on the northwest side of the reservoir by mounding clay across a minor tributary valley to the reservoir. The pond is connected to the main reservoir by a short, riprap-lined channel, with a bridge over the channel (Photo 4).

Since the dam construction in 1968, there have been no reported changes to the facility.

h. **Normal operating procedures.** No operating records or procedures were found. Flood flows pass over the uncontrolled spillway at the right (southeast) abutment.

1.3 Pertinent Data

a. **Drainage area.** Approximately 0.18 mi^2

b. **Discharge at dam site.**

Maximum known flood at damsite	Unknown
Warm water outlet at pool elevation	Not applicable (N/A)

Diversion tunnel low pool outlet at pool elevation	N/A
Diversion tunnel outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	N/A
Gated spillway capacity at maximum pool elevation	N/A
Ungated spillway capacity at maximum pool elevation	50 ft^3/sec
Total spillway capacity at maximum pool elevation	50 ft^3/sec

c. **Elevations (ft above MSL).**

Top Dam	1107.8 to 1109.9
Maximum pool-design surcharge	N/A
Full flood control pool	N/A
Recreation pool	1105.7
Spillway crest (gated)	N/A
Upstream portal invert diversion tunnel	N/A
Downstream portal invert diversion tunnel	N/A
Streambed at centerline of dam	Unknown
Maximum tailwater	N/A
Toe of dam at maximum section	1084.5

d. **Reservoir.**

Length of maximum pool (estimated)	1230 ft
Length of recreation pool (estimated)	1200 ft
Length of flood control pool	N/A

e. **Storage (acre-feet).**

Recreation pool	160
Flood control pool	N/A
Design surcharge	N/A
Top of dam	180

f. **Reservoir surface (acres).**

Top of dam	12.3

Maximum pool	12.3
Flood-control pool	N/A
Recreation pool	11.2
Spillway crest	11.2

g. **Dam.**

Type	Equipment - rolled, earth
Length	430 ft
Height	25 ft
Top width	6 to 10 ft
Side slopes	Upstream 3(H) to 1(V) (reported by Mr Gudaitis) Downstream 2(H) to 1(V) (observed)
Zoning	Unknown (probably none)
Impervious core	None
Cutoff	Trench to shallow rock surface
Grout curtain	None

h. **Diversion and regulating tunnel.** None

i. **Spillway.**

Type	"V" notch, grass-lined on gravelly clay
Length of weir	Approximately 28 ft at elevation of top of dam
Crest elevation	1105.7 ft MSL
Gates	None
Upstream channel	None
Downstream channel	In situ clay, grass- and gravel-lined

j. **Regulating outlets.** None

SECTION 2
ENGINEERING DATA

2.1 Design

No design drawings or reports have been found for this dam.

2.2 Construction

No construction reports have been found on this dam. Mr John Gudaitis, owner of the property on which the dam and reservoir are situated, indicates the dam was constructed in 1968 and is founded on shallow bedrock. See Section 1.2g for further information.

2.3 Operation

There are no mechanical control structures on this dam. There are no records of the flow history over the spillway. Normal operation is reported to include some flow over the spillway during periods of heavy precipitation. Mr Gudaitis does not maintain a permanent residence at the lake.

2.4 Evaluation

a. **Availability.** Engineering data was obtained through personal interviews with Mr Gudaitis.

b. **Adequacy.** The available engineering data and information is insufficient to evaluate the design of the Gudaitis Lake Dam. Seepage and stability analyses comparable to the guidelines are not on record. This is a deficiency which should be rectified. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. These analyses should be performed by an engineer experienced in the design and construction of dams.

c. **Validity.** The data obtained from Mr Gudaitis appears to be sound and factual, but the information was not confirmed by an outside source and is incomplete.

2.5 Project Geology

The dam site lies on the northwestern flank of the Ozark structural dome. The regional dip is to the northwest. The bedrock in the area consists of Cambrian age Eminence and Potosi dolomite formations (Fig 4). The Potosi Formation is a light gray, medium- to fine-grained dolomite and typically contains an abundance of quartz druse characteristic of chert-bearing formations. The Eminence Formation comformably overlies the Potosi Formation and is similar in appearance to the Potosi Formation, but contains less quartz and chert. Some large springs and caves have been noted in the Eminence Formation; however, no evidence of springs or solution cavities was identified during the visual inspection of the dam site.

The soil at the dam site is a stoney, dark red-brown, plastic residual clay (CL-CH), characteristically developed on Potosi Formation. It is locally overlain by thin (2 to 5 ft) loess profile consisting of clay and silt (ML). The soils in this area are mapped on the Missouri General Soils Map as Union-Goss-Gasconade-Peridge Association.

The Gudaitis Lake dam is located about 1/2 mi south of a branch of the Palmer Fault System. This system is a complex network of short and long faults mapped on the Structural Features Map of Missouri as about 43 mi long. It is mapped as north side up. The fault system is mapped offsetting Pre-Cambrian and lower Paleozoic units and is likely Paleozoic in age. The area is not seismically active and the faults are not considered to pose a significant hazard to the dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. **General.** A field inspection was made of the Gudaitis Lake Dam on 17 July 1980 without the owner's representative present. The dam is currently in generally fair condition.

b. **Dam.** The dam is constructed of a gravelly, silty clay soil, with about 30 percent angular gravel (quartz druse). The soil is a dark red-brown, plastic residual clay (CL-CH). The dam has a moderate to low erosion potential due to its good cohesion and vegetative cover. The upstream face has had the fine soil particles washed out by wave action, leaving the gravel-sized portion. There is also one row of logs on the upstream face to act as wave erosion protection, but these do not appear to be significantly effective (Photo 5).

The dam crest did not exhibit any lateral spreading, shifting, or vertical settling (Photo 6). No evidence of any sinkhole development was observed during our inspection.

The downstream face was heavily vegetated with berry bushes, small trees and some larger trees (12 in. diameter). The slopes did not appear to have undergone any movement; however, the thick vegetation obscured some of the face and subtle bulges indicating incipient slope instability could not be readily identified. The slope appeared bumpy but the bumps are probably due to the construction methods and not due to slope movement.

Seepage of approximately 1 to 2 gallons per minute was noted along the toe of the dam for about 40 ft, as shown in Fig A-1. The seepage is collected in a 1 ft wide, drainage ditch that runs along the dam toe. The ground in the area of seepage was spongy and swampy but very little movement of water was observed. The seepage did not appear to be transporting any soil particles.

Some crawfish burrows were noted but did not appear to be significant. There were no cracks apparent in the dam, and there was no unusual movement or cracking at or beyond the dam toe.

c. **Appurtenant structures.** The "V" notch, grass-lined spillway is cut into the southeast abutment and the hillside, running slightly downslope (Photo 3 and Fig A-1). Mr Gudaitis reported that the spillway carries water during moderate rains ("moderate" being undefined). There is no evidence of prior instability or significant erosion in the spillway. The spillway area would be moderately erodible if the downhill side of the discharge channel was overtopped. Such an event would increase the flow velocity and could cause headward channel erosion. If the spillway and discharge channel were eroded, floodwaters would run near the downstream face and along the toe of the dam.

d. **Reservoir area.** The slopes surrounding the reservoir are heavily vegetated (Photo 4), with grasses and trees. The slopes are approximately 5(H) to 1(V) or flatter. No evidence of instability was noted during the visual inspection. The beach face of the reservoir has been eroded by wave action and rill wash. There was no gullying seen, but the fine soil particles have been winnowed out of the banks leaving gravel along the bank (Photos 4 and 8).

There have been no major changes in the drainage basin, such as road or building construction, that would increase sedimentation in the reservoir. Sedimentation records were not available.

e. **Downstream channel.** The spillway discharge channel is unlined and does not appear to be maintained. The in situ soil is a stoney, silty, residual clay (CL-CH) that has been eroded slightly at the low points of the channel. The channel runs along the hillside at approximately 1 degree slope, and is contained by a mounded ridge of residual clay soil. Extensive erosion has occurred approximately 225 ft downstream (about 175 ft from the dam toe) where the channel flow runs directly downslope at a gradient of approximately 2 to 3(H) to 1(V). This indicates that if the low ridge is overtopped close to the dam, the ridge could be eroded quickly and could endanger the toe of the dam.

No trees are present within the first 225 ft of constructed spillway discharge channel, but the banks of this narrow channel section are bordered by many trees. The entire downstream area is heavily forested and has many potential flow obstructions. Photos 2, 4 and 5 show the extent and density of vegetation.

3.2 Evaluation

The visual inspection identified several items of concern, which left unchecked may in time contribute to the deterioration of the dam. The spillway and downstream discharge channel are essentially unlined and potentially erodible. The discharge channel is not adequately confined and erosion protection is especially needed on the low ridge on the northern sidewall of the channel. The downstream face of the dam is heavily vegetated with trees and large bushes. Some of this vegetation should be removed under the supervision of an engineer experienced in the design of earth dams. Seepage at the toe of the dam is relatively extensive in area but the amount of flow is small and it is not currently transporting any soil particles. The seepage should be monitored to identify any changes in turbidity or amount of flow.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No facilities requiring operation were identified at this dam site. Water level in the reservoir is controlled by the ungated spillway. Normal operating procedure is to allow natural drainage through the spillway.

4.2 Maintenance of the Dam

No records of maintenance were identified for this dam. The only identifiable maintenance performed on the dam was the cutting of grass on the dam crest.

4.3 Maintenance of Operating Facilities

No facilities requiring operation exist at this dam.

4.4 Description of Any Warning System in Effect

A warning system was not identified in the inspection.

4.5 Evaluation

There is no formal maintenance program in effect for this dam. Maintenance is especially recommended on the downstream face of the dam. Some of the bushes and trees should be removed under the guidance of an engineer experienced in the design of dams. Indiscriminate clearing of the trees could endanger the dam. The spillway and spillway discharge channel require maintenance to provide erosion control, possible redesign and enlargement, and removal of major obstructions. The development of a maintenance program and an evaluation of a practical and effective warning system are recommended for this facility.

SECTION 5
HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. **Design data.** No hydrologic or hydraulic information was available for evaluation of the dam. Pertinent dimensions of the dam and reservoir were surveyed on 2 July 1980, measured during the field inspection, or estimated from the topographic mapping. The topographic map used in the analysis was the USGS, Palmer, Missouri 7.5 minute quadrangle map.

b. **Experience data.** No history of recorded rainfall, runoff, discharge, pool stage data or overtopping were available for this reservoir or watershed.

c. **Visual observation.**

1. Watershed. The watershed is predominantly rural and wooded.

2. Reservoir. The reservoir impounded by the earth embankment is about 10 percent of the total drainage area of 0.18 mi^2.

3. Spillway. The spillway is located at the southeast end of the dam (Photo 2). It is excavated in the natural ground and has little vegetative growth (Photo 3). The open channel spillway carries flow into the downstream discharge channel. The spillway discharge channel lies on the slope of the southeastern valley sidewall. Therefore, there is a possibility of flow spilling out of the discharge channel and eroding the bank of the channel. This may represent a potential danger to the downstream toe of the dam.

4. Seepage. The magnitude of seepage through the dam is not hydraulically significant to the overtopping potential.

d. **Overtopping potential.** Hydrologic and hydraulic analyses indicate that the one percent probability-of-occurrence event (100 year flood) will result in overtopping the dam. These analyses also indicate that a flood greater than 12 percent of the Probable Maximum Flood (PMF) will effectively overtop the dam. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. There is no overtopping history available for this dam. No evidence of prior overtopping was observed during our visual inspection.

The following data for various flood events were computed assuming the shape of the spillway, downstream channel and dam crest are not altered by erosion:

Percent PMF	Maximum Reservoir W.S. Elev., ft	Maximum Depth Over Dam, ft	Maximum Outflow, ft^3/sec	Duration of Overtopping, hrs
12	1107.7	0	46	0
50	1109.6	1.8	680	7.3
100	1110.1	2.3	1540	10.7

Hydraulic analysis indicates the spillway outflow capacity is limited by the shape of the downstream discharge channel. The HEC-2 backwater computer program has calculated the spillway rating to be 50 ft^3/sec at the point of overtopping of the dam embankment.

It should be noted that for 50 and 100 percent of the PMF the flow will be overtopping the dam to a significant depth for a long period of time. Although the flow velocity in the spillway is not expected to reach 5 ft/sec (the approximate erosion velocity for the embankment material), erosion would very likely occur on the downstream face of the dam during overtopping due to the depth of flow, duration of overtopping and the steepness of the dam face. Erosion of the low ridge that confines the discharge channel is also likely in the event this ridge is overtopped.

The proximity of the downstream structures and their apparent location and elevation in relationship to the dam and downstream channel, and the relatively narrow valley downstream of the dam are the basis for recommending 100 percent of the PMF as the spillway design flood. The more detailed and accurate hydrulic/hydrologic analyses which are recommended in this report may show that a design for somewhat less than 100 percent of the PMF can be justified on the basis of safety considerations.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. ***Visual observations.*** *The visual inspection of* Gudaitis Lake Dam revealed that it is structurally in generally fair condition. There was no evidence of lateral spreading or horizontal displacement of the dam crest. No evidence of sinkholes near the dam or in the surrounding area was noted. No cracking on the dam or in the visible area beyond the dam toe was identified. There were no slumps noted although the downstream face was bumpy. These bumps are judged to have occurred due to construction procedure and not due to slope instability. The downstream face was heavily vegetated with trees and bushes and partially obscured from sight. These trees and bushes will significantly inhibit proper inspection of the dam if they are allowed to remain. Also, deep tree roots may in time provide piping paths through the dam.

The slow seepage which was noted did not appear to be transporting soil particles. This seepage should be monitored and the amount of flow and turbidity of the seepage should be checked periodically.

The spillway is in good condition at present. It is lined with grass and some gravel. The erosion potential is judged to be moderate. An erosion control system should be evaluated and installed.

The spillway discharge channel is in relatively good condition in the area near the dam. It is expected however, that erosion will continue in the downstream area indicated in Fig A-1, Appendix A. The channel is moderately erodible, and should therefore have erosion protection in the zone near the dam. The spillway and the discharge channel should be enlarged to carry the design flood, and the channel and spillway should be protected against erosion.

During periods of high flows, the trees that line the banks of the spillway discharge channel could be toppled and obstruct flow. These trees should be removed, under the guidance of an engineer experienced in the design of earth dams. Indiscriminate clearing of trees could jeopardize the safety of the dam.

b. **Design and construction data.** No design or construction records were available for this dam. All information on the construction of the dam was obtained through Mr John Gudaitis, *owner and builder of the dam,* and is recorded in section 1.2.g. of this report.

c. **Operating records.** No operating records or water level records are maintained for this facility.

d. **Post construction changes.** There have been no post construction changes on this dam other than the growth of trees, grass and bushes on the downstream dam face and discharge channel.

e. **Seismic stability.** The dam is in Seismic Zone 2 to which the guidelines assign a moderate damage potential. During a seismic event, liquefaction of the gravelly, silty clay dam material is unlikely. However, without knowledge of soil properties of the embankment materials the seismic stability of the dam cannot be evaluated.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. **Safety.** Based on the visual inspection, the dam appears to be in fair condition. Inadequate spillway capacity is the primary reason for this judgment. Seepage and stability analyses comparable to the requirements in the guidelines are not on record, which is a deficiency. The hydraulic/hydrologic analyses of the spillway, dam, and the reservoir storage indicate that the dam will pass only 12 percent of the PMF without overtopping. The relatively narrow downstream valley and the apparent elevation of the occupied dwellings in the hazard zone near the stream elevation indicate 100 percent of the PMF should be used as the spillway design flood.

b. **Adequacy of information.** The visual inspection provided sufficient information to support the recommendations presented in this Phase I investigation. The lack of design documents such as static and seismic stability analyses and seepage analysis precludes an evaluation of the static and seismic stability of the dam. This is a deficiency which should be corrected.

c. **Urgency.** The deficiencies described in this report could affect the safety of the dam. Remedial measures should be initiated without undue delay.

d. **Necessity for Phase II.** In accordance with the Recommended Guidelines for Safety Inspection of Dams, the subject investigation was a minimum study. This study revealed that additional in-depth investigations are needed to complete the assessment of the safety of the dam. Those investigations which should be performed without undue delay are described in Section 7.2.b. It is our understanding from discussions with the SLD that any additional investigations are the responsibility of the owner.

7.2 Remedial Measures

a. **Alternatives.** There are several general options which may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these options are:

1. Remove the dam, or breach it to prevent storage of water.

2. Increase the height of dam and/or spillway size to pass the PMF without overtopping the dam.

3. Purchase downstream land that would be adversely impacted by dam failure, and restrict human occupancy.

4. Provide a highly reliable flood warning system (generally does not prevent damage but diminishes chances for loss of life).

b. **Recommendations.** Based on our inspection of the Gudaitis Lake Dam, it is recommended that the following topics be evaluated without undue delay:

1. Prepare a more detailed hydraulic/hydrologic analysis and design a spillway and discharge channel capable of passing 100 percent of the PMF without overtopping the embankment or discharge channel. The analysis should also include implementation of an erosion control system for the spillway and discharge channel. This is especially needed for the spillway discharge channel's northern bank from its intersection with the dam to a point downstream where the dam will not be jeopardized by potential erosion.

2. Remove trees and large bushes on the downstream face of the dam. Also remove potential flow obstructions from the spillway discharge channel This should be done under the supervision of personnel experienced in the design and construction of earthen dams. Indiscriminate clearing could jeopardize the safety of the dam.

The following topics should be addressed as soon as practical:

3. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" should be performed.

4. Investigation of the feasibility of a warning system to alert downstream residents should potentially hazardous conditions develop during periods of heavy precipitation.

All remedial measures should be evaluated and performed under the guidance of an engineer experienced in the design and construction of earth dams.

c. **O & M procedures.** As there are no operation facilities per se, it is recommended that a program of periodic inspections be developed and implemented as soon as practical. This program should identify, as a minimum, evidence of instability such as cracking or slumping on the embankment, and to monitor seepage from the toe of the dam. Changes in conditions such as increased seepage volume or turbidity in the seepage water should be evaluated. Maintenance should include maintaining of the spillway discharge channel and the dam slopes free of potential obstructions such as trees and bushes. Records of the inspections and maintenance should be kept.

All inspections and maintenance should be evaluated and/or performed by an engineer experienced in the design and construction of earth dams.

REFERENCES

Allgood, Ferris P., and Persinger, Ivan, D., 1979, "Missouri General Soil Map and Soil Association Descriptions," US Department of Agriculture, Soil Conservation Service and Missouri Agricultural Experiment Station.

Department of the Army, Office of the Chief of Engineers, 1977, EC 1110-2-188, "National Program of Inspection of Non-Federal Dams".

Department of the Army, Office of the Chief of Engineers, 1979, ER 1110-2-106, "National Program of Inspection of Non-Federal Dams".

Hydrologic Engineering Center, US Army Corps of Engineers, 1978, "Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations".

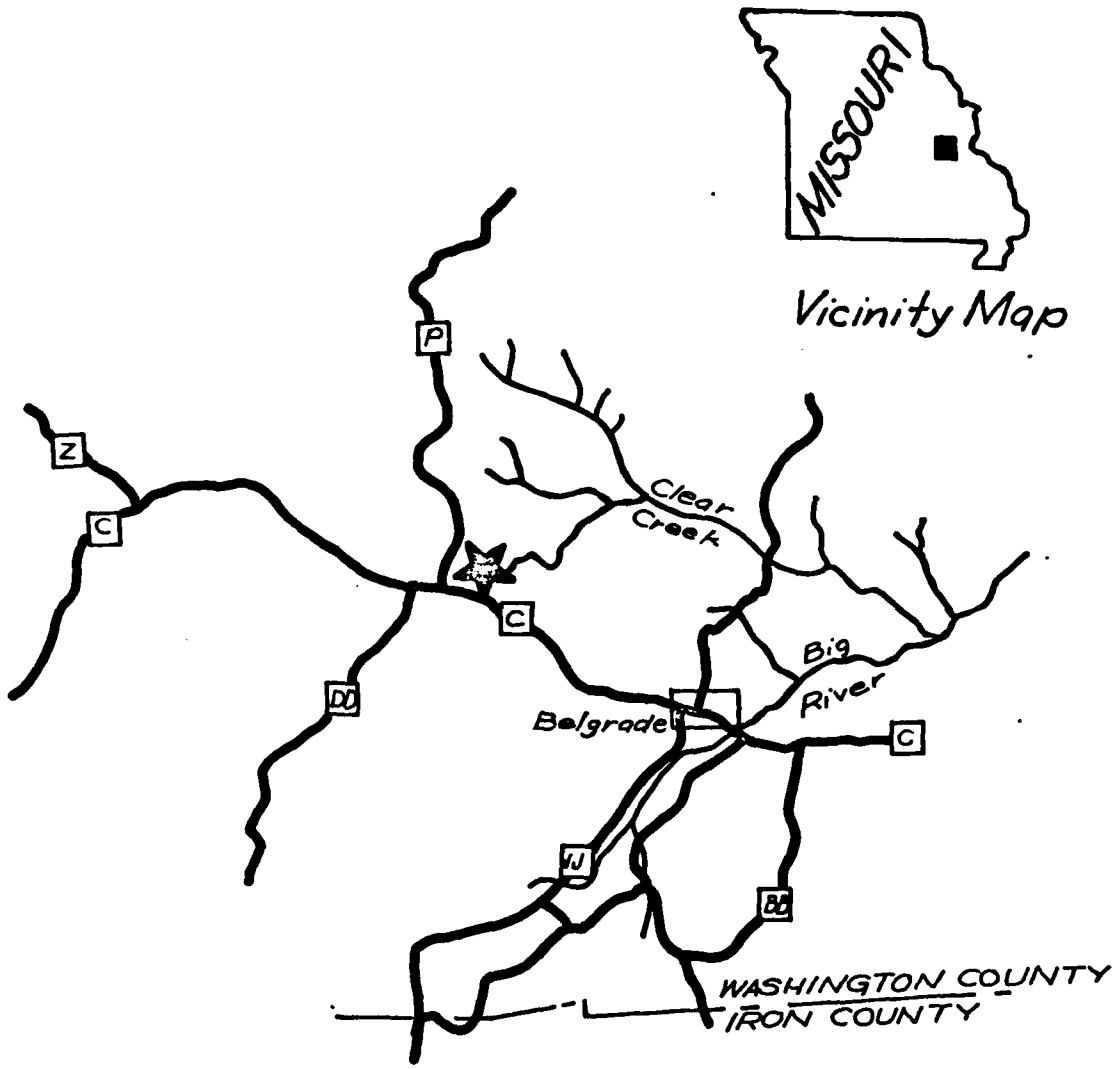
McCracken, Mary H., 1971, Structural Features Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

Missouri Geological Survey, 1979, Geologic Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

St Louis District, US Army Corps of Engineers, 1979, "Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams".

US Department of Commerce, US Weather Bureau, 1956, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 Hours," Hydrometeorological Report No. 33.

US Soil Conservation Service, 1971, "National Engineering Handbook," Section 4, Hydrology, 1971.



0 2 4

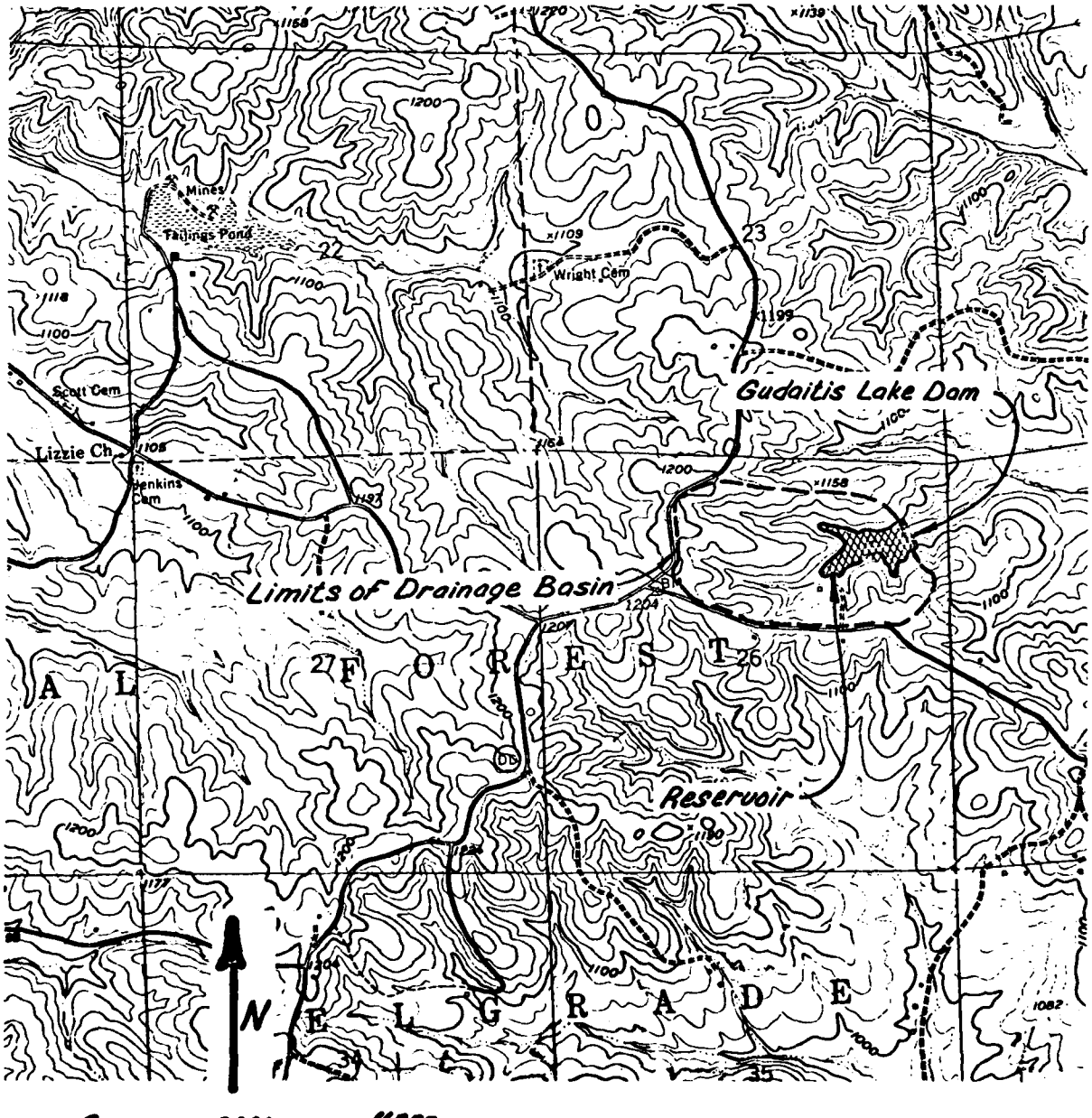
Scale, miles

N

Legend

- County Line
- State highway and Route No.
- River or Creek
- City or Town
- Project location

SITE LOCATION MAP	
GUDAITIS LAKE DAM	
MO 30702	Fig. 1

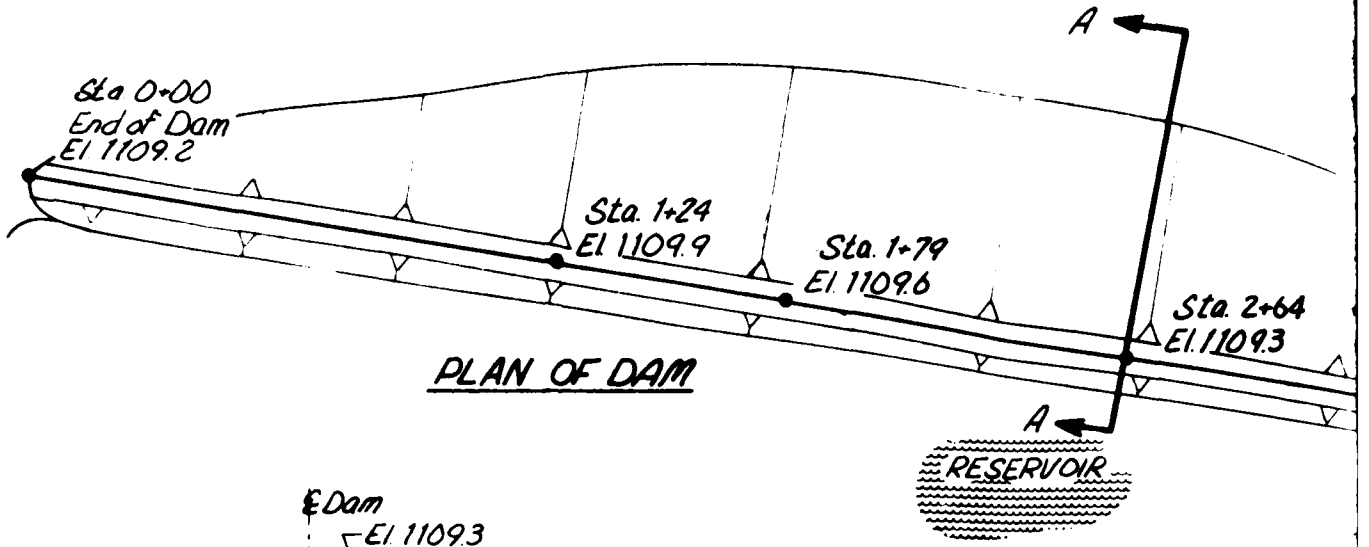


1. Topography from U.S.G.S. Palmer 7½ minute quadrangle map.

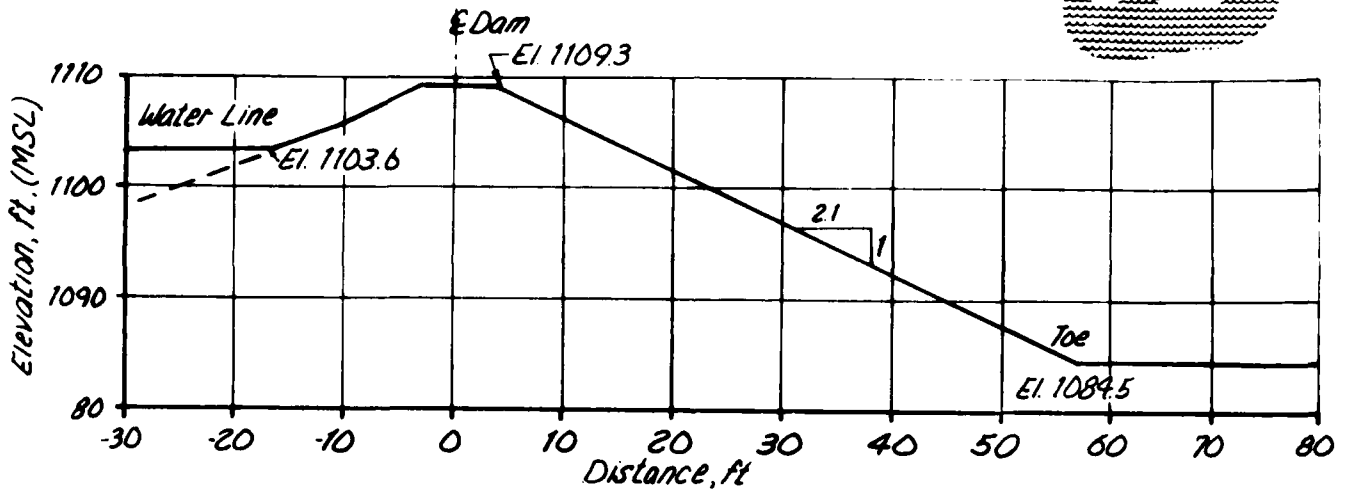
DRAINAGE BASIN AND SITE TOPOGRAPHY

GUDAITIS LAKE DAM

MO 30702 | Fig. 2

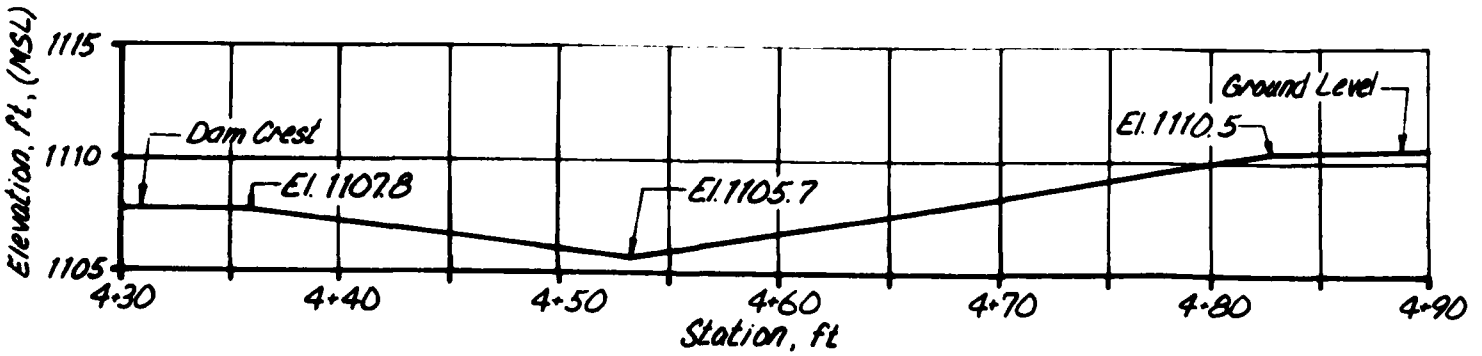


PLAN OF DAM



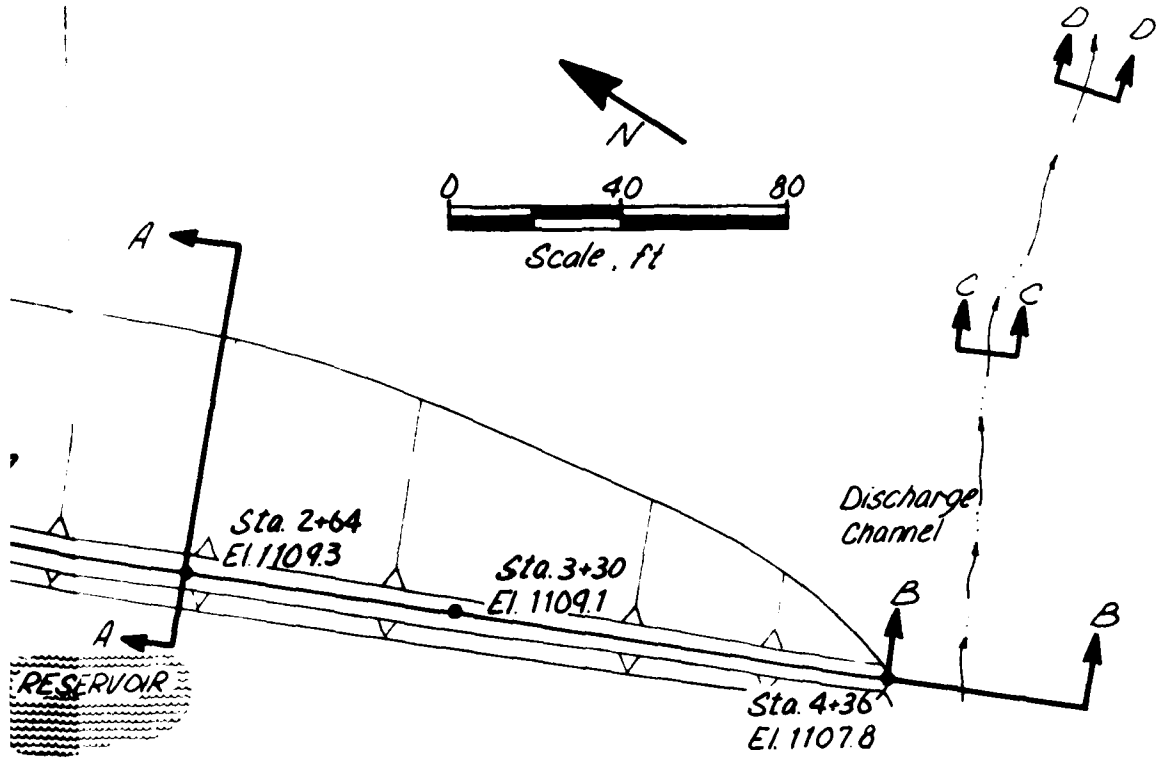
SECTION A-A

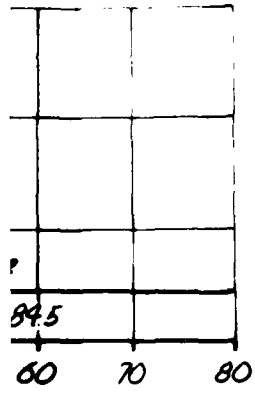
Maximum Section

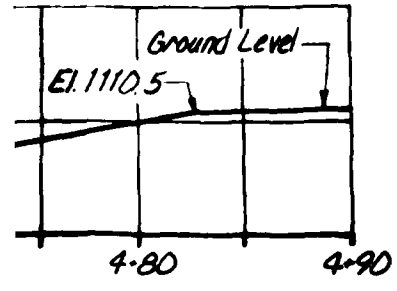


SECTION B-B

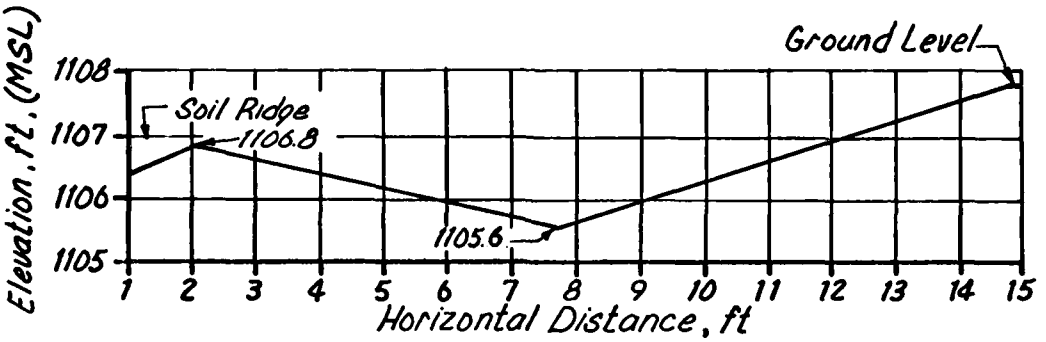
Spillway



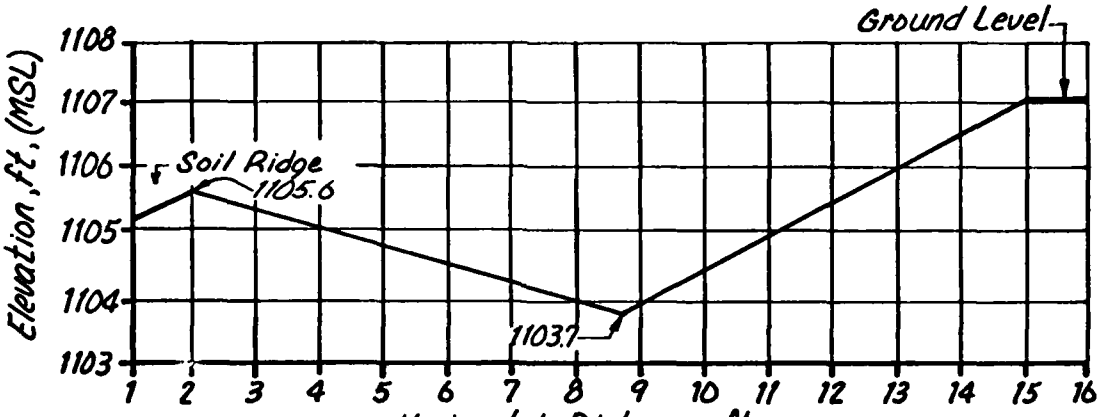




PLAN AND SECTIONS OF DAM AND SPILLWAY	
GUDAITIS LAKE DAM.	
MO 30702	Fig. 3-A

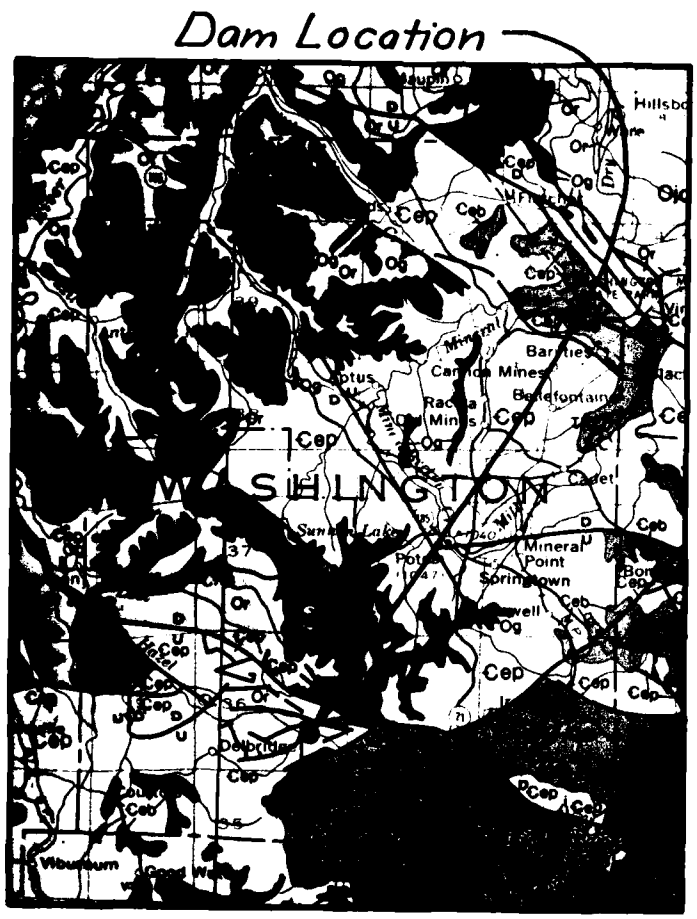


SECTION C-C
Discharge Channel



SECTION D-D
Discharge Channel

SECTIONS OF DISCHARGE CHANNEL	
GUDAITIS LAKE DAM	
MO 30702	Fig. 3-B



Legend

- Or — Roubidoux Formation
- Gasconade Dolomite
  - Gunter Sandstone Member
- Cep — Eminence Dolomite
- Potosi Dolomite
- Derby-Doerun Dolomite
- Davis Formation
- Bonneterre Formation
  - Whetstone Creek Member
  - Sullivan Siltstone Member
- Reagan Sandstone (subsurface, western Missouri)
- Lamotte Sandstone
- Diabase (dikes and sills)
- St. Francois Mountains Intrusive Suite
- St. Francois Mountains Volcanic Supergroup

REGIONAL GEOLOGIC MAP

GUDAITIS LAKE DAM

MO 30702 | Fig. 4

APPENDIX A

Photographs

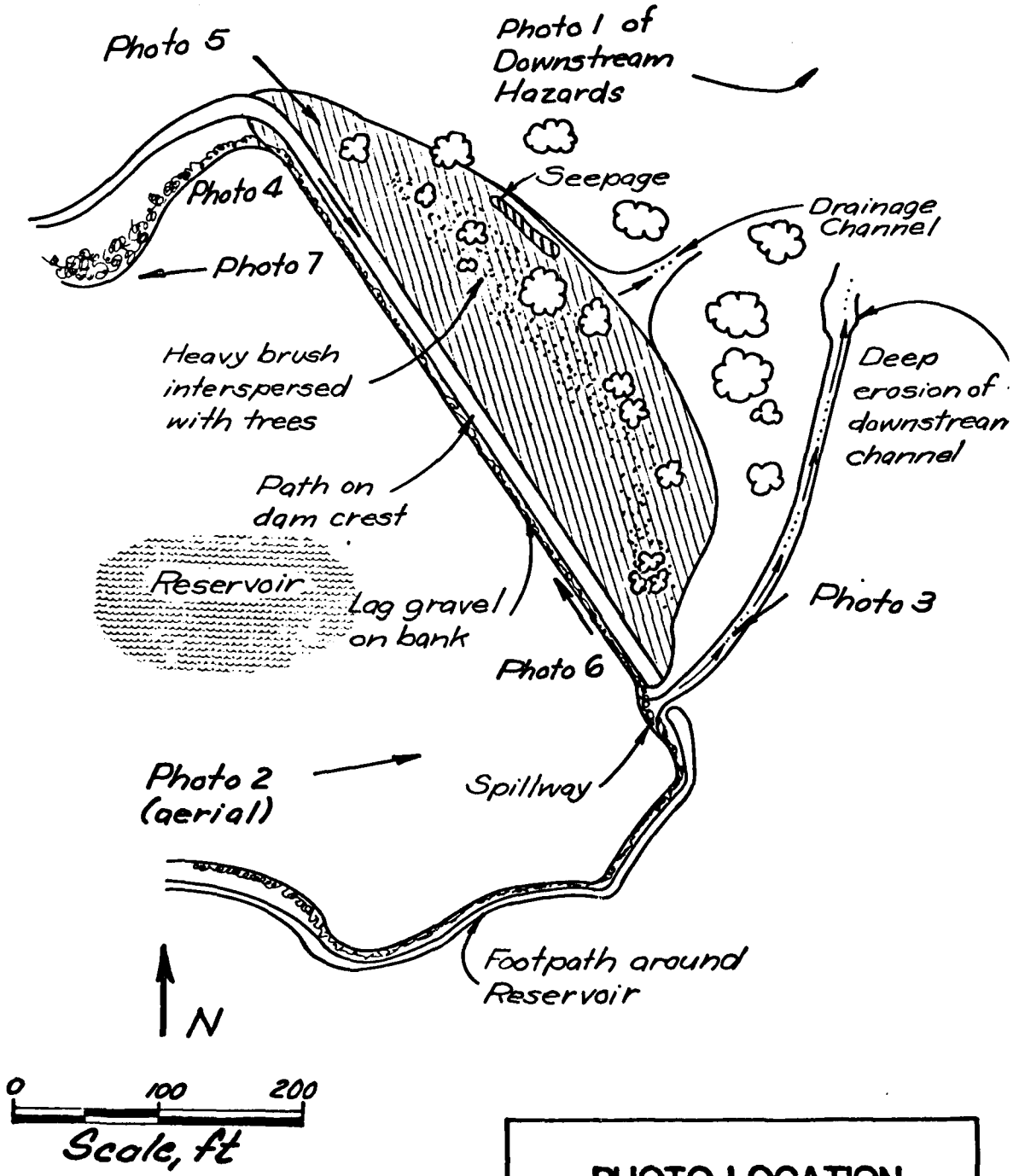
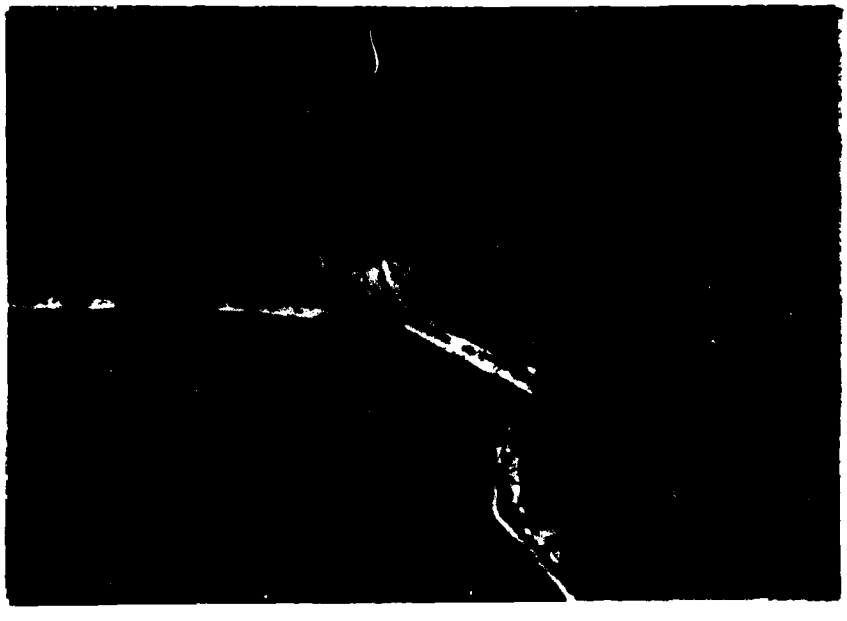


PHOTO LOCATION SKETCH

GUDAITIS LAKE DAM

MO 30702 | Fig. A-1

1. Downstream hazards below Gudaitis Lake Dam. Looking southeast.

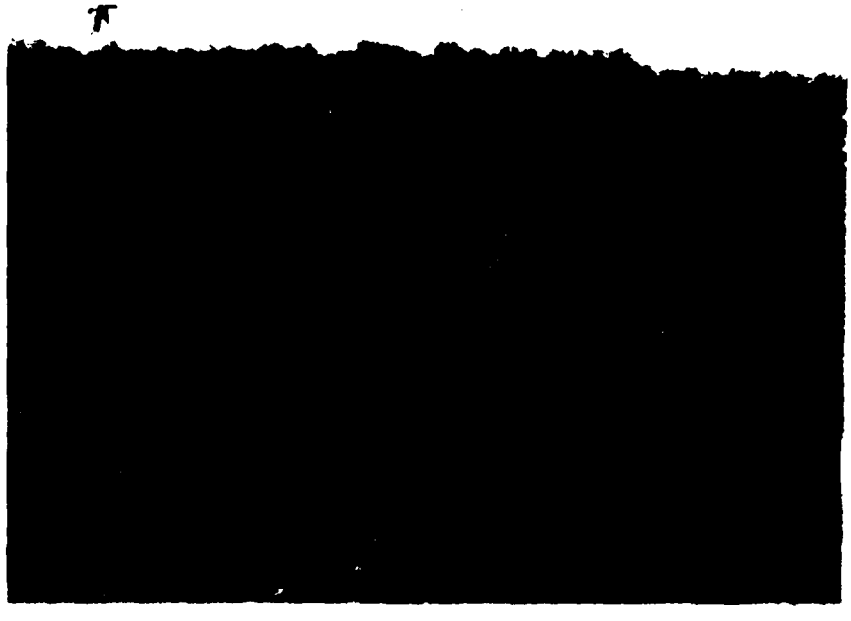


2. Spillway area for Gudaitis Lake Dam. Note heavy vegetation along discharge channel. Looking east.

3. Spillway and downstream discharge channel area. Note shallowness and soil banks of the discharge channel. Dam crest is to the right. Looking southwest.

4. View of entire reservoir. Note the small pond on the left, the spillway on the right, and the clearing for the electric transmission line in the background. Looking northeast.

5. Upstream face of dam looking northwest. Note vegetation and lag gravel on bank. Stake at right is to hold wave erosion control log in place.



6. Dam crest looking southeast. Note vegetation on downstream face and dam crest. Spillway area is in the background.

7. Dam crest looking southeast. Note vegetation on downstream face.

8. Reservoir banks looking northwest. Note slight wave erosion of banks and slope.

APPENDIX B

Hydraulic/Hydrologic Data and Analyses

APPENDIX B
Hydraulic/Hydrologic Data and Analyses

B.1 Procedures

a. General. The hydraulic/hydrologic analyses were performed using the "HEC-1, Dam Safety Version (1 Apr 80)" computer program. The inflow hydrographs were developed for various precipitation events by applying them to a synthetic unit hydrograph. The inflow hydrographs were subsequently routed through the reservoir and appurtenant structures by the modified Puls reservoir routing option.

b. Precipitation events. The Probable Maximum Precipitation (PMP) and the 1 and 10 percent probability-of-occurrence events were used in the analyses. The total rainfall and corresponding distributions for the 1 and 10 percent probability events were provided by the St. Louis District, Corps of Engineers. The Probable Maximum Precipitation was determined from regional curves prepared by the US Weather Bureau (Hydrometeorological Report Number 33, 1956).

c. Unit hydrograph. The Soil Conservation Services (SCS) Dimensionless Unit Hydrograph method (National Engineering Handbook, Section 4, Hydrology, 1971) was used in the analysis. This method was selected because of its simplicity, applicability to drainage areas less than 10 mi^2, and its easy availability within the HEC-1 computer program.

The watershed lag time was computed using the SCS "curve number method" by an empirical relationship as follows:

$$L = \frac{\ell^{0.8}\,(s+1)^{0.7}}{1900\,Y^{0.5}} \qquad \text{(Equation 15-4)}$$

where: L = lag in hours
ℓ = hydraulic length of the watershed in feet
$s = \frac{1000}{CN} - 10$ where CN = hydrologic soil curve number
Y = average watershed land slope in percent

This empirical relationship accounts for the soil cover, average watershed slope and hydraulic length.

With the lag time thus computed, another empirical relationship is used to compute the time of concentration as follows:

$$T_c = \frac{L}{0.6} \qquad \text{(Equation 15-3)}$$

where: T_c = time of concentration in hours

L = lag in hours.

Subsequent to the computation of the time of concentration, the unit hydrograph duration was estimated utilizing the following relationship:

$$\Delta D = 0.133 T_c \qquad \text{(Equation 16-12)}$$

where: ΔD = duration of unit excess rainfall
T_c = time of concentration in hours.

The final interval was selected to provide at least three discharge ordinates prior to the peak discharge ordinate of the unit hydrograph. For this dam, a time interval of 5 minutes was used.

d. Infiltration losses. The infiltration losses were computed by the HEC-1 computer program internally using the SCS curve number method. The curve numbers were established taking into consideration the variables of: (a) antecedent moisture condition, (b) hydrologic soil group classification, (c) degree of development, (d) vegetative cover and (e) present land usage in the watershed.

Antecedent moisture condition III (AMC III) was used for the PMF events and AMC II was used for the 1 and 10 percent probability events, in accordance with the guidelines. The remaining variables are defined in the SCS procedure and judgements in their selection were made on the basis of visual field inspection.

e. Starting elevations. Reservoir starting water surface elevations for this dam were set as follows:

(1) 1 and 10 percent probability events - spillway crest elevation

(2) Probable Maximum Storm - spillway crest elevation

f. Spillway Rating Curve. The HEC-2 computer program was used to compute the spillway rating curve using discharge channel cross sections and conveyance characteristics. The discharge channel is shallow and lies on the hillslope. There is a possibility of the flow spilling over the northern side of the discharge channel. The following assumptions were used in calculating the backwater profile in the discharge channel:

(1) The discharge does not leave the channel between the surveyed cross sections B and C.

(2) The critical depth was assumed as a composite cross section which consists of two sections, one across the discharge channel (surveyed cross section D), and the other parallel to the discharge channel along the length of the spill between cross sections C and D.

B.2 Pertinent Data

a. Drainage area. 0.18 mi^2

b. Storm duration. A unit hydrograph was developed by the SCS method option of HEC-1 program. The design storm of 24 hours duration was divided into 5-minute intervals in order to develop the inflow hydrograph.

c. Lag time. 0.34 hrs

d. Hydrologic soil group. C

e. SCS curve numbers.

1. For PMF- AMC III - Curve Number 89
2. For 1 and 10 percent probability-of-occurrence events AMC II - Curve Number 76

f. Storage. Elevation-area data were developed by planimetering areas at various elevation contours on the USGS Palmer 7.5 minute quadrangle map. The data were entered on the $A and $E cards so that the HEC-1 program could compute storage volumes.

g. Outflow over dam crest. As the profile of the dam crest is irregular, flow over the crest was computed according to the "Flow Over Non-Level Dam Crest" supplement to the HEC-1 User's Manual. The crest length-elevation data and hydraulic constants were entered on the $D, $L, and $V cards.

h. Outflow capacity. The spillway rating curve was developed from the cross-section data of the spillway and the downstream channel, using the HEC-2 back water program. The results of the above were entered on the Y-4 and Y-5 cards of the HEC-1 program.

i. Reservoir elevations. For the 50 and 100 percent of the PMF events, the starting reservoir elevation was 1105.7 ft, the spillway crest elevation. For the 1 and 10 percent probability-of-occurrence events, the starting reservoir elevation was also 1105.7 ft, the spillway crest elevation.

B.3 Results

The results of the analyses as well as the input values to the HEC-1 program follow in this Appendix. Only the results summaries are included, not the intermediate output. Complete copies of the HEC-1 and HEC-2 output are available in the project files.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
**********
....1.          A1      DAM NO. 30702 - GUDAITIS LAKE, WASHINGTON COUNTY, MISSOURI.
     2          A2      WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
     3          A3      PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.
     4          B   288       0       5      -0      -0      -0      -0      -0      -0      -0
     5          B1    5
     6          J     1       4       1
     7          J1  .25     .50     .75     1.0
     8          K     0    Q-IN                                                    1
     9          K1  GUDAITIS LAKE INFLOW COMPUTATION, PMF RATIO FLOODS.
    10          M     1       2    0.18                      1.                             1
    11          P     0      26.    102.    120.    130.
    12          T                                                      -1     -89              .10
    13          M2          0.34
    14          X    -1    -.05       9
    15          K     1     DAM                                                1
    16          K1  GUDAITIS LAKE PMF FLOOD ROUTINGS.
    17          Y                                      1       1
    18          Y1    1                                                 -1105.7      -1
    19          Y41105.7  1106.9  1107.8  1108.6  1109.1  1109.7  1110.6
    20          Y5    0.    10.0    50.0   100.0   150.0   200.0   300.0
    21          $A  2.7     8.1    11.2    12.3    18.9
    22          $E1080.0  1100.0  1105.7  1107.8  1120.0
    23          $S1105.7
    24          $D1107.8     2.8     1.5
    25          $L    0.     40.     85.    180.    400.    445.
    26          $V1107.8  1108.3  1108.8  1109.3  1109.8  1110.3
    27          K    99
    ..
```

Input Data
Various PMF Events
Gudaitis Lake Dam
MO 30702

B4

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
**********

 RUN DATE= 12 AUG 80
     TIME= 11.57.09

                DAM NO. 30702 - GUDAITIS LAKE, WASHINGTON COUNTY, MISSOURI.
                WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
                PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.

                                  JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         288        0        5       -0       -0       -0       -0       -0       -0       -0
                                   JOPER      NVT   LROPT    TRACE
                                       5       -0       -0       -0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 4 LRTIO= 1
                    RTIOS=     .25      .50      .75     1.00

**********      **********      **********      **********      **********

                                SUB-AREA RUNOFF COMPUTATION

          GUDAITIS LAKE INFLOW COMPUTATION, PMF RATIO FLOODS.

                    ISTAQ   ICOMP   IECON   ITAPE   JPLT    JPRT   INAME  ISTAGE   IAUTO
                     0-IN       0      -0      -0      -0      -0       1      -0      -0

                                  HYDROGRAPH DATA
          IHYDG     IUHG    TAREA     SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1        2      .18       -0.     .18    1.00      -0.      -0       1      -0

                                    PRECIP DATA
                    SPFE     PMS      R6      R12     R24     R48     R72     R96
                      0.   26.00  102.00  120.00  130.00      -0.     -0.     -0.

                                    LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
             -0      -0.     -0.    1.00      -0.     -0.    1.00   -1.00  -89.00      -0.     .10

          CURVE NO =  -89.00  WETNESS =   -1.00  EFFECT CN =   89.00

                                UNIT HYDROGRAPH DATA
                              TC= -0.      LAG=   .34

                                RECESSION DATA
                    STRTQ=   -1.00     QRCSN=    -.05     RTIOR= 5.00

          UNIT HYDROGRAPH 22 END-OF-PERIOD ORDINATES, TC=   -0.   HOURS, LAG=   .34  VOL= 1.00
            27.     84.    170.    222.    226.    194.    147.     97.     68.     48.
            33.     24.     17.     12.      8.      6.      4.      3.      2.      2.
             1.      0.

     0                          END-OF-PERIOD FLOW
```

B5

Output Summary
Various PMF Events
Gudaitis Lake Dam
MO 30702

	27.	84.	170.	222.	226.	194.	147.	97.	68.	48.
	33.	24.	17.	12.	8.	6.	4.	3.	2.	2.
	1.	0.								

END-OF-PERIOD FLOW												
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.22	.21	.01	92.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.22	.21	.01	104.
1.01	.15	3	.01	.00	.01	1.	1.01	12.15	147	.22	.22	.01	116.
1.01	.20	4	.01	.00	.01	1.	1.01	12.20	148	.22	.22	.01	164.
1.01	.25	5	.01	.00	.01	1.	1.01	12.25	149	.22	.22	.01	192.
1.01	.30	6	.01	.00	.01	1.	1.01	12.30	150	.22	.22	.00	228.
1.01	.35	7	.01	.00	.01	2.	1.01	12.35	151	.22	.22	.00	251.
1.01	.40	8	.01	.00	.01	2.	1.01	12.40	152	.22	.22	.00	266.
1.01	.45	9	.01	.00	.01	2.	1.01	12.45	153	.22	.22	.00	276.
1.01	.50	10	.01	.00	.01	2.	1.01	12.50	154	.22	.22	.00	284.
1.01	.55	11	.01	.00	.01	2.	1.01	12.55	155	.22	.22	.00	289.
1.01	1.00	12	.01	.00	.01	2.	1.01	13.00	156	.22	.22	.00	293.
1.01	1.05	13	.01	.00	.01	2.	1.01	13.05	157	.27	.26	.00	297.
1.01	1.10	14	.01	.00	.01	2.	1.01	13.10	158	.27	.26	.00	303.
1.01	1.15	15	.01	.00	.01	2.	1.01	13.15	159	.27	.26	.00	312.
1.01	1.20	16	.01	.00	.01	2.	1.01	13.20	160	.27	.26	.00	323.
1.01	1.25	17	.01	.00	.01	2.	1.01	13.25	161	.27	.26	.00	332.
1.01	1.30	18	.01	.00	.01	2.	1.01	13.30	162	.27	.26	.00	340.
1.01	1.35	19	.01	.00	.01	2.	1.01	13.35	163	.27	.26	.00	350.
1.01	1.40	20	.01	.00	.01	2.	1.01	13.40	164	.27	.26	.00	359.
1.01	1.45	21	.01	.00	.01	2.	1.01	13.45	165	.27	.26	.00	359.
1.01	1.50	22	.01	.00	.01	2.	1.01	13.50	166	.27	.26	.00	360.
1.01	1.55	23	.01	.00	.01	3.	1.01	13.55	167	.27	.26	.00	362.
1.01	2.00	24	.01	.00	.01	3.	1.01	14.00	168	.27	.26	.00	369.
1.01	2.05	25	.01	.00	.01	3.	1.01	14.05	169	.33	.33	.00	386.
1.01	2.10	26	.01	.00	.01	3.	1.01	14.10	170	.33	.33	.00	392.
1.01	2.15	27	.01	.00	.01	4.	1.01	14.15	171	.33	.33	.00	394.
1.01	2.20	28	.01	.00	.01	4.	1.01	14.20	172	.33	.33	.00	399.
1.01	2.25	29	.01	.00	.01	4.	1.01	14.25	173	.33	.33	.00	414.
1.01	2.30	30	.01	.00	.01	5.	1.01	14.30	174	.33	.33	.00	427.
1.01	2.35	31	.01	.00	.01	5.	1.01	14.35	175	.33	.33	.00	439.
1.01	2.40	32	.01	.00	.01	5.	1.01	14.40	176	.33	.33	.00	443.
1.01	2.45	33	.01	.01	.01	6.	1.01	14.45	177	.33	.33	.00	448.
1.01	2.50	34	.01	.01	.01	6.	1.01	14.50	178	.33	.33	.00	451.
1.01	2.55	35	.01	.01	.01	6.	1.01	14.55	179	.33	.33	.00	454.
1.01	3.00	36	.01	.01	.01	7.	1.01	15.00	180	.33	.33	.00	455.
1.01	3.05	37	.01	.01	.01	7.	1.01	15.05	181	.20	.20	.00	453.
1.01	3.10	38	.01	.01	.01	7.	1.01	15.10	182	.40	.40	.00	448.
1.01	3.15	39	.01	.01	.01	7.	1.01	15.15	183	.40	.40	.00	444.
1.01	3.20	40	.01	.01	.01	8.	1.01	15.20	184	.60	.60	.00	455.
1.01	3.25	41	.01	.01	.01	8.	1.01	15.25	185	.71	.70	.00	490.
1.01	3.30	42	.01	.01	.01	8.	1.01	15.30	186	1.71	1.71	.01	980.
1.01	3.35	43	.01	.01	.01	8.	1.01	15.35	187	2.82	2.81	.01	1778.
1.01	3.40	44	.01	.01	.01	9.	1.01	15.40	188	1.11	1.11	.00	1679.
1.01	3.45	45	.01	.01	.01	9.	1.01	15.45	189	.71	.70	.00	1468.
1.01	3.50	46	.01	.01	.01	9.	1.01	15.50	190	.60	.60	.00	1409.
1.01	3.55	47	.01	.01	.01	9.	1.01	15.55	191	.40	.40	.00	1339.
1.01	4.00	48	.01	.01	.01	9.	1.01	16.00	192	.40	.40	.00	1914.
1.01	4.05	49	.01	.01	.01	10.	1.01	16.05	193	.31	.31	.00	1312.
1.01	4.10	50	.01	.01	.01	10.	1.01	16.10	194	.31	.31	.00	1047.
1.01	4.15	51	.01	.01	.01	10.	1.01	16.15	195	.31	.31	.00	924.
1.01	4.20	52	.01	.01	.01	10.	1.01	16.20	196	.31	.31	.00	785.
1.01	4.25	53	.01	.01	.01	10.	1.01	16.25	197	.31	.31	.00	694.
1.01	4.30	54	.01	.01	.01	10.	1.01	16.30	198	.31	.31	.00	605.
1.01	4.35	55	.01	.01	.01	11.	1.01	16.35	199	.31	.31	.00	555.
1.01	4.40	56	.01	.01	.01	11.	1.01	16.40	200	.31	.31	.00	518.
1.01	4.45	57	.01	.01	.01	11.	1.01	16.45	201	.31	.31	.00	492.

Output Summary
Various PMF Events
Gudaitis Lake Dam
MO 30702

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1.01	4.10	50	.01	.01	.01	10.	1.01	16.10	194	.31	.31	.00	1057.
1.01	4.15	51	.01	.01	.01	10.	1.01	16.15	195	.31	.31	.00	524.
1.01	4.20	52	.01	.01	.01	10.	1.01	16.20	196	.31	.31	.00	785.
1.01	4.25	53	.01	.01	.01	10.	1.01	16.25	197	.31	.31	.00	654.
1.01	4.30	54	.01	.01	.01	10.	1.01	16.30	198	.31	.31	.00	605.
1.01	4.35	55	.01	.01	.01	11.	1.01	16.35	199	.31	.31	.00	595.
1.01	4.40	56	.01	.01	.01	11.	1.01	16.40	200	.31	.31	.00	510.
1.01	4.45	57	.01	.01	.01	11.	1.01	16.45	201	.31	.31	.00	492.
1.01	4.50	58	.01	.01	.01	11.	1.01	16.50	202	.31	.31	.00	474.
1.01	4.55	59	.01	.01	.01	11.	1.01	16.55	203	.31	.31	.00	461.
1.01	5.00	60	.01	.01	.01	11.	1.01	17.00	204	.31	.31	.00	452.
1.01	5.05	61	.01	.01	.01	11.	1.01	17.05	205	.24	.24	.00	444.
1.01	5.10	62	.01	.01	.01	12.	1.01	17.10	206	.24	.24	.00	434.
1.01	5.15	63	.01	.01	.01	12.	1.01	17.15	207	.24	.24	.00	419.
1.01	5.20	64	.01	.01	.01	12.	1.01	17.20	208	.24	.24	.00	401.
1.01	5.25	65	.01	.01	.01	12.	1.01	17.25	209	.24	.24	.00	384.
1.01	5.30	66	.01	.01	.01	12.	1.01	17.30	210	.24	.24	.00	370.
1.01	5.35	67	.01	.01	.01	12.	1.01	17.35	211	.24	.24	.00	360.
1.01	5.40	68	.01	.01	.01	12.	1.01	17.40	212	.24	.24	.00	353.
1.01	5.45	69	.01	.01	.01	13.	1.01	17.45	213	.24	.24	.00	349.
1.01	5.50	70	.01	.01	.01	13.	1.01	17.50	214	.24	.24	.00	346.
1.01	5.55	71	.01	.01	.00	13.	1.01	17.55	215	.24	.24	.00	343.
1.01	6.00	72	.01	.01	.00	13.	1.01	18.00	216	.24	.24	.00	342.
1.01	6.05	73	.07	.04	.02	14.	1.01	18.05	217	.02	.02	.00	335.
1.01	6.10	74	.07	.05	.02	17.	1.01	18.10	218	.02	.02	.00	314.
1.01	6.15	75	.07	.05	.02	23.	1.01	18.15	219	.02	.02	.00	277.
1.01	6.20	76	.07	.05	.02	31.	1.01	18.20	220	.02	.02	.00	228.
1.01	6.25	77	.07	.05	.02	39.	1.01	18.25	221	.02	.02	.00	178.
1.01	6.30	78	.07	.05	.02	47.	1.01	18.30	222	.02	.02	.00	135.
1.01	6.35	79	.07	.05	.01	53.	1.01	18.35	223	.02	.02	.00	102.
1.01	6.40	80	.07	.05	.01	57.	1.01	18.40	224	.02	.02	.00	81.
1.01	6.45	81	.07	.05	.01	61.	1.01	18.45	225	.02	.02	.00	69.
1.01	6.50	82	.07	.05	.01	64.	1.01	18.50	226	.02	.02	.00	59.
1.01	6.55	83	.07	.05	.01	66.	1.01	18.55	227	.02	.02	.00	50.
1.01	7.00	84	.07	.05	.01	68.	1.01	19.00	228	.02	.02	.00	43.
1.01	7.05	85	.07	.05	.01	69.	1.01	19.05	229	.02	.02	.00	38.
1.01	7.10	86	.07	.05	.01	71.	1.01	19.10	230	.02	.02	.00	35.
1.01	7.15	87	.07	.05	.01	72.	1.01	19.15	231	.02	.02	.00	34.
1.01	7.20	88	.07	.06	.01	73.	1.01	19.20	232	.02	.02	.00	33.
1.01	7.25	89	.07	.06	.01	74.	1.01	19.25	233	.02	.02	.00	32.
1.01	7.30	90	.07	.06	.01	75.	1.01	19.30	234	.02	.02	.00	31.
1.01	7.35	91	.07	.06	.01	76.	1.01	19.35	235	.02	.02	.00	31.
1.01	7.40	92	.07	.06	.01	76.	1.01	19.40	236	.02	.02	.00	30.
1.01	7.45	93	.07	.06	.01	77.	1.01	19.45	237	.02	.02	.00	30.
1.01	7.50	94	.07	.06	.01	77.	1.01	19.50	238	.02	.02	.00	30.
1.01	7.55	95	.07	.06	.01	78.	1.01	19.55	239	.02	.02	.00	30.
1.01	8.00	96	.07	.06	.01	79.	1.01	20.00	240	.02	.02	.00	30.
1.01	8.05	97	.07	.06	.01	79.	1.01	20.05	241	.02	.02	.00	30.
1.01	8.10	98	.07	.06	.01	79.	1.01	20.10	242	.02	.02	.00	30.
1.01	8.15	99	.07	.06	.01	80.	1.01	20.15	243	.02	.02	.00	30.
1.01	8.20	100	.07	.06	.01	80.	1.01	20.20	244	.02	.02	.00	30.
1.01	8.25	101	.07	.06	.01	81.	1.01	20.25	245	.02	.02	.00	30.
1.01	8.30	102	.07	.06	.01	81.	1.01	20.30	246	.02	.02	.00	30.
1.01	8.35	103	.07	.06	.01	81.	1.01	20.35	247	.02	.02	.00	30.
1.01	8.40	104	.07	.06	.01	82.	1.01	20.40	248	.02	.02	.00	30.
1.01	8.45	105	.07	.06	.01	82.	1.01	20.45	249	.02	.02	.00	30.
1.01	8.50	106	.07	.06	.01	82.	1.01	20.50	250	.02	.02	.00	30.
1.01	8.55	107	.07	.06	.00	83.	1.01	20.55	251	.02	.02	.00	30.
1.01	9.00	108	.07	.06	.00	83.	1.01	21.00	252	.02	.02	.00	30.
1.01	9.05	109	.07	.06	.00	83.	1.01	21.05	253	.02	.02	.00	30.
1.01	9.10	110	.07	.06	.00	83.	1.01	21.10	254	.02	.02	.00	30.
1.01	9.15	111	.07	.06	.00	83.	1.01	21.15	255	.02	.02	.00	30.
1.01	9.20	112	.07	.06	.00	84.	1.01	21.20	256	.02	.02	.00	30.
1.01	9.25	113	.07	.06	.00	84.	1.01	21.25	257	.02	.02	.00	30.

1.01	8.00	96	.07	.06	.01	79.	1.01	20.00	240	.02	.02	.00	30.
1.01	8.05	97	.07	.06	.01	79.	1.01	20.05	241	.02	.02	.00	30.
1.01	8.10	98	.07	.06	.01	79.	1.01	20.10	242	.02	.02	.00	30.
1.01	8.15	99	.07	.06	.01	80.	1.01	20.15	243	.02	.02	.00	30.
1.01	8.20	100	.07	.06	.01	80.	1.01	20.20	244	.02	.02	.00	30.
1.01	8.25	101	.07	.06	.01	81.	1.01	20.25	245	.02	.02	.00	30.
1.01	8.30	102	.07	.06	.01	81.	1.01	20.30	246	.02	.02	.00	30.
1.01	8.35	103	.07	.06	.01	81.	1.01	20.35	247	.02	.02	.00	30.
1.01	8.40	104	.07	.06	.01	82.	1.01	20.40	248	.02	.02	.00	30.
1.01	8.45	105	.07	.06	.01	82.	1.01	20.45	249	.02	.02	.00	30.
1.01	8.50	106	.07	.06	.01	82.	1.01	20.50	250	.02	.02	.00	30.
1.01	8.55	107	.07	.06	.00	83.	1.01	20.55	251	.02	.02	.00	30.
1.01	9.00	108	.07	.06	.00	83.	1.01	21.00	252	.02	.02	.00	30.
1.01	9.05	109	.07	.06	.00	83.	1.01	21.05	253	.02	.02	.00	30.
1.01	9.10	110	.07	.06	.00	83.	1.01	21.10	254	.02	.02	.00	30.
1.01	9.15	111	.07	.06	.00	83.	1.01	21.15	255	.02	.02	.00	30.
1.01	9.20	112	.07	.06	.00	84.	1.01	21.20	256	.02	.02	.00	30.
1.01	9.25	113	.07	.06	.00	84.	1.01	21.25	257	.02	.02	.00	30.
1.01	9.30	114	.07	.06	.00	84.	1.01	21.30	258	.02	.02	.00	30.
1.01	9.35	115	.07	.06	.00	84.	1.01	21.35	259	.02	.02	.00	30.
1.01	9.40	116	.07	.06	.00	84.	1.01	21.40	260	.02	.02	.00	30.
1.01	9.45	117	.07	.06	.00	85.	1.01	21.45	261	.02	.02	.00	30.
1.01	9.50	118	.07	.06	.00	85.	1.01	21.50	262	.02	.02	.00	30.
1.01	9.55	119	.07	.06	.00	85.	1.01	21.55	263	.02	.02	.00	30.
1.01	10.00	120	.07	.06	.00	85.	1.01	22.00	264	.02	.02	.00	30.
1.01	10.05	121	.07	.06	.00	85.	1.01	22.05	265	.02	.02	.00	30.
1.01	10.10	122	.07	.06	.00	85.	1.01	22.10	266	.02	.02	.00	30.
1.01	10.15	123	.07	.06	.00	86.	1.01	22.15	267	.02	.02	.00	30.
1.01	10.20	124	.07	.06	.00	86.	1.01	22.20	268	.02	.02	.00	30.
1.01	10.25	125	.07	.06	.00	86.	1.01	22.25	269	.02	.02	.00	30.
1.01	10.30	126	.07	.06	.00	86.	1.01	22.30	270	.02	.02	.00	30.
1.01	10.35	127	.07	.06	.00	86.	1.01	22.35	271	.02	.02	.00	30.
1.01	10.40	128	.07	.06	.00	86.	1.01	22.40	272	.02	.02	.00	30.
1.01	10.45	129	.07	.06	.00	86.	1.01	22.45	273	.02	.02	.00	30.
1.01	10.50	130	.07	.06	.00	86.	1.01	22.50	274	.02	.02	.00	30.
1.01	10.55	131	.07	.06	.00	86.	1.01	22.55	275	.02	.02	.00	30.
1.01	11.00	132	.07	.06	.00	87.	1.01	23.00	276	.02	.02	.00	30.
1.01	11.05	133	.07	.06	.00	87.	1.01	23.05	277	.02	.02	.00	30.
1.01	11.10	134	.07	.06	.00	87.	1.01	23.10	278	.02	.02	.00	30.
1.01	11.15	135	.07	.06	.00	87.	1.01	23.15	279	.02	.02	.00	30.
1.01	11.20	136	.07	.06	.00	87.	1.01	23.20	280	.02	.02	.00	30.
1.01	11.25	137	.07	.06	.00	87.	1.01	23.25	281	.02	.02	.00	30.
1.01	11.30	138	.07	.06	.00	87.	1.01	23.30	282	.02	.02	.00	30.
1.01	11.35	139	.07	.06	.00	87.	1.01	23.35	283	.02	.02	.00	30.
1.01	11.40	140	.07	.06	.00	87.	1.01	23.40	284	.02	.02	.00	30.
1.01	11.45	141	.07	.06	.00	87.	1.01	23.45	285	.02	.02	.00	30.
1.01	11.50	142	.07	.06	.00	87.	1.01	23.50	286	.02	.02	.00	30.
1.01	11.55	143	.07	.06	.00	87.	1.01	23.55	287	.02	.02	.00	30.
1.01	12.00	144	.07	.06	.00	87.	1.02	0.	288	.02	.02	.00	30.
									SUM	33.80	32.90	1.30	45146.
										(859.1(	826.1(	33.1(	1278.29)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1633.	502.	157.	157.	45134.
CMS	46.	14.	4.	4.	1278.
INCHES		29.94	32.40	32.40	32.40
MM		658.79	822.86	822.86	822.86
AC-FT		249.	311.	311.	311.
THOUS CU M		307.	383.	383.	383.

HYDROGRAPH AT STA 0-IN END PLAN 1, RTIO 1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS			
				RATIO 1	RATIO 2	RATIO 3	RATIO 4
				.25	.50	.75	1.00
HYDROGRAPH AT	Q-IN	.18	1	408.	816.	1224.	1633.
		(.47)		(11.56)	(23.11)	(34.67)	(46.23)
ROUTED TO	DAM	.18	1	221.	681.	1123.	1546.
		(.47)		(6.26)	(19.29)	(31.79)	(43.79)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1105.70	1105.70	1107.80
	STORAGE	158.	158.	183.
	OUTFLOW	0.	0.	90.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	1108.81	1.01	195.	221.	4.58	16.25	0.
.50	1109.56	1.76	205.	681.	7.25	16.08	0.
.75	1109.90	2.10	210.	1123.	8.50	16.00	0.
1.00	1110.14	2.34	213.	1546.	10.67	16.00	0.

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Output Summary
Various PMF Events
Gudaitis Lake Dam
MO 30702

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .11	RATIO 2 .12	RATIO 3 .13
HYDROGRAPH AT	Q-IN	.18 (.47)	1	180. (5.09)	196. (5.55)	212. (6.01)
ROUTED TO	DAM	.18 (.47)	1	40. (1.14)	46. (1.30)	52. (1.48)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1105.70	1105.70	1107.80
	STORAGE	158.	158.	183.
	OUTFLOW	0.	0.	90.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.11	1107.58	0.	180.	40.	0.	17.50	0.
.12	1107.71	0.	182.	46.	0.	17.42	0.
.13	1107.83	.03	183.	52.	1.98	17.33	0.

Output Summary
Various PMF Events
Gudaitis Lake Dam
MO 30702

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END

DATE
FILMED

11-81

DTIC